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2: Rubin PD, Murthy VS, Hansen RG, Pietrowiak C. Related Articles, Links

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J Biol Chem. 1987 Jan 25;262(3):1010-5.
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J Orthop Res. 1987;5(2):300-10.
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1: Rubin CT, Lanyon LE.

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Kappa Delta Award paper. Osteoregulatory nature of mechanical stimuli: function as a determinant for adaptive remodeling in bone.
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2: Rubin CT, Pratt GW, Porter AL, Lanyon LE, Poss R.

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The use of ultrasound in vivo to determine acute change in the mechanical properties of bone following intense physical activity.
J Biomech. 1987;20(7):723-7.
PMID: 3308891 [PubMed - indexed for MEDLINE]

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1: J Biomech. 1987;20(7):723-7.

Related Articles, Links

The use of ultrasound in vivo to determine acute change in the mechanical properties of bone following intense physical activity.

Rubin CT, Pratt GW, Porter AL, Lanyon LE, Poss R.

Brigham and Women's Hospital, Harvard Medical School, Boston, MA 02111.

The velocity of ultrasound was measured transcutaneously across the patella and tibia in 98 volunteers both before and after running the 26 mile Boston Marathon. Absolute sound velocities were 2.9% higher in those runners finishing before 3 h when compared to runners finishing after 3 h. Tibial velocities in males were 8.8% higher than in female runners. The mean velocity across the patella of three wheelchair racers was 28% lower than the mean combined patella velocity measured in all runners. These data suggest that 'faster' velocities are associated with bone that is better suited for high functional demands. Surprisingly, when pre- and post-race velocities were compared in each runner, there was a 1.6% increase in ultrasonic velocity across the tibia, and a 3.5% increase across the patella. An increase in ultrasonic velocity following extreme physical activity suggests that adaptive mechanisms exist in healthy bone to withstand, or possibly avoid, the microdamage which might be caused by repetitive cyclic loading.

PMID: 3308891 [PubMed - indexed for MEDLINE]

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The effect of low-frequency electrical fields on osteogenesis.
J Bone Joint Surg Am. 1992 Jul;74(6):920-9. Erratum in: J Bone Joint Surg Am 1992 Sep;74(8):1274.
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Calcif Tissue Int. 1992 Apr;50(4):306-13.
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1: J Bone Joint Surg Am. 1992 Jul;74(6):920-9.

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Erratum in:

- J Bone Joint Surg Am 1992 Sep;74(8):1274.

The effect of low-frequency electrical fields on osteogenesis.

McLeod KJ, Rubin CT.

Department of Orthopaedics, School of Medicine, State University of New York, Stony Brook 11794-8181.

An in vivo animal model of disuse osteopenia was used to determine the osteogenic potential of specific components of electrical fields. The ability of a complex pulsed electrical field to inhibit loss of bone was compared with the remodeling response generated by extremely low-power, low-frequency (fifteen, seventy-five, and 150-hertz) sinusoidal electrical fields. The left ulnae of thirty adult male turkeys were functionally isolated by creation of distal and proximal epiphyseal osteotomies and then were exposed, for one hour each day, to an electrical field that had been induced exogenously by means of magnetic induction. After a fifty-six-day protocol, the remodeling response was quantified by a comparison of the cross-sectional area of the mid-part of the diaphysis of the functionally isolated ulna with that of the intact contralateral ulna. Disuse resulted in a 13 per cent mean loss of osseous tissue, which was not significantly different than the 10 per cent loss that was caused by disuse treated with inactive coils. Exposure to the pulsed electrical fields prevented this osteopenia and stimulated a 10 per cent mean increase in the bone area. The osteogenic influence of the sinusoidal electrical fields was strongly dependent on the frequency; the 150, seventy-five, and fifteen-hertz sinusoidal fields, respectively, generated a -3 per cent, + 5 per cent, and + 20 per cent mean change in the bone area. These results suggest a tissue sensitivity that is specific to very low-frequency sinusoidal electrical fields, and they imply that the induced electrical fields need not have complex waveforms to be osteogenic. Since the frequency and intensity range of the sinusoidal fields producing the greatest osteogenic response are similar to the levels produced intrinsically by normal functional activity, these results support the hypothesis that electricity plays a role in the retention of the normal remodeling balance within mature bone.

PMID: 1634583 [PubMed - indexed for MEDLINE]

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1: Tabrah F, Hoffmeier M, Gilbert F Jr, Batkin S, Bassett CA. Related Articles, Links

Bone density changes in osteoporosis-prone women exposed to pulsed electromagnetic fields (PEMFs).
J Bone Miner Res. 1990 May;5(5):437-42.
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1: J Bone Miner Res. 1990 May;5(5):437-42.

Related Articles, Links

Bone density changes in osteoporosis-prone women exposed to pulsed electromagnetic fields (PEMFs).

Tabrah F, Hoffmeier M, Gilbert F Jr, Batkin S, Bassett CA.

University of Hawaii School of Medicine, Straub Clinic and Hospital, Honolulu.

To determine the effect of a 72 Hz pulsating electromagnetic field (PEMF) on bone density of the radii of osteoporosis-prone women, the nondominant forearms of 20 subjects were exposed to PEMF 10 h daily for a period of 12 weeks. Bone density before, during, and after the exposure period was determined by use of a Norland-Cameron bone mineral analyzer. Bone mineral densities of the treated radii measured by single-photon densitometry increased significantly in the immediate area of the field during the exposure period and decreased during the following 36 weeks. A similar but weaker response occurred in the opposite arm, suggesting a "cross-talk" effect on the nontreated radii, from either possible arm proximity during sleep or very weak general field effects. The data suggest that properly applied PEMFs, if scaled for whole-body use, may have clinical application in the prevention and treatment of osteoporosis.

Publication Types:

- Clinical Trial

PMID: 2195843 [PubMed - indexed for MEDLINE]

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1: Aaron RK, Lennox D, Bunce GE, Ebert T. Related Articles, Links

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Clin Orthop. 1989 Dec;(249):209-18.
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2: Aaron RK, Ciombor DM, Jolly G. Related Articles, Links

Stimulation of experimental endochondral ossification by low-energy pulsing electromagnetic fields.
J Bone Miner Res. 1989 Apr;4(2):227-33.
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3: Froehlich JA, Dorfman GS, Cronan JJ, Urbanek PJ, Herndon JH, Aaron RK. Related Articles, Links

Compression ultrasonography for the detection of deep venous thrombosis in patients who have a fracture of the hip. A prospective study.
J Bone Joint Surg Am. 1989 Feb;71(2):249-56.
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4: Aaron RK, Jolly G, Ciombor DM, Barrach HJ. Related Articles, Links

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1: J Bone Miner Res. 1989 Apr;4(2):227-33.

Related Articles, Links

Stimulation of experimental endochondral ossification by low-energy pulsing electromagnetic fields.

Aaron RK, Ciombor DM, Jolly G.

Department of Biochemistry and Biophysics, University of Rhode Island, Providence.

Pulsed electromagnetic fields (PEMFs) of certain configuration have been shown to be effective clinically in promoting the healing of fracture nonunions and are believed to enhance calcification of extracellular matrix. In vitro studies have suggested that PEMFs may also have the effect of modifying the extracellular matrix by promoting the synthesis of matrix molecules. This study examines the effect of one PEMF upon the extracellular matrix and calcification of endochondral ossification in vivo. The synthesis of cartilage molecules is enhanced by PEMF, and subsequent endochondral calcification is stimulated. Histomorphometric studies indicate that the maturation of bone trabeculae is also promoted by PEMF stimulation. These results indicate that a specific PEMF can change the composition of cartilage extracellular matrix in vivo and raises the possibility that the effects on other processes of endochondral ossification (e.g., fracture healing and growth plates) may occur through a similar mechanism.

PMID: 2728926 [PubMed - indexed for MEDLINE]

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